MST e-NEWS

February 2011

INSIDE

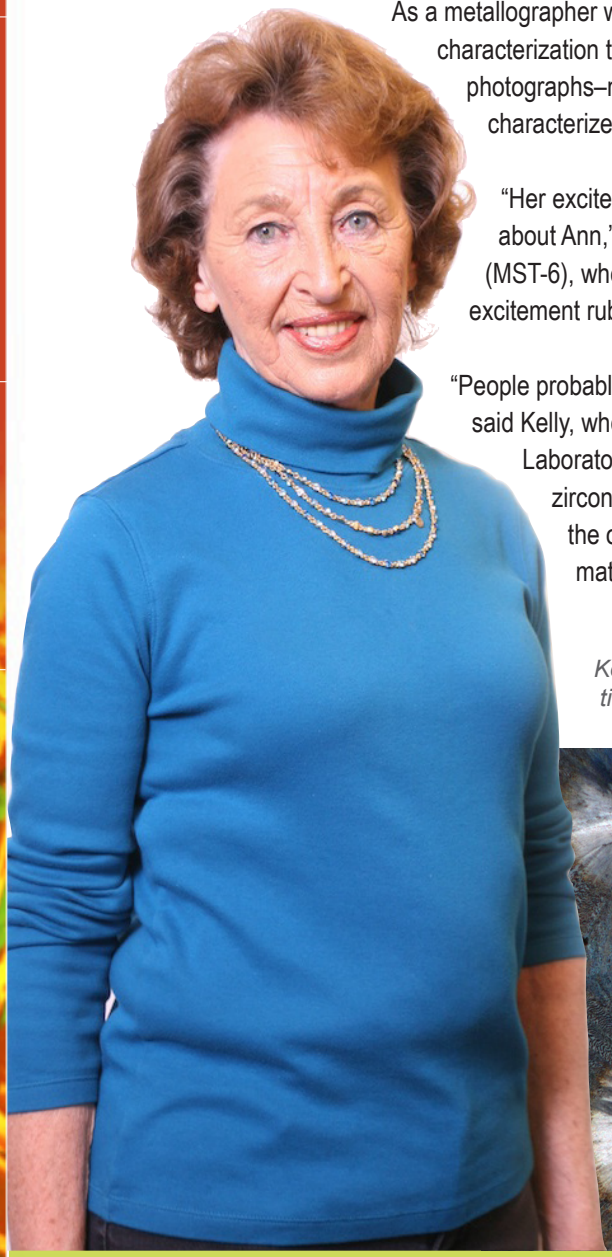


# Ann Kelly

## *Characterized by a passion for metallography*

by Francisco Ojeda
ADEPS Communications

When Ann Kelly talks about metallography, her voice gets louder and intensifies. When she gets excited about a micrograph, she tries to show it to everybody. When she describes her micrographs, she uses words like "cool," "awesome" and "pretty." It's hard to miss Kelly's passion for her work.



As a metallographer with the Materials Technology-Metallurgy (MST-6) characterization team, Kelly uses a microscope to take magnified photographs–micrographs–of metals and alloys in order to characterize their physical composition or structure.

"Her excitement for metallography is the first thing you notice about Ann," said Characterization Team Leader James Foley (MST-6), who has worked with Kelly for four years. "And that excitement rubs off on other people."

"People probably think I'm crazy because I love my job so much," said Kelly, who during 26 of her 31 years at Los Alamos National Laboratory has studied everything from aluminum to zirconium. "I have fun. I love it. Where else do you get the opportunity to work with such a wide variety of materials?"

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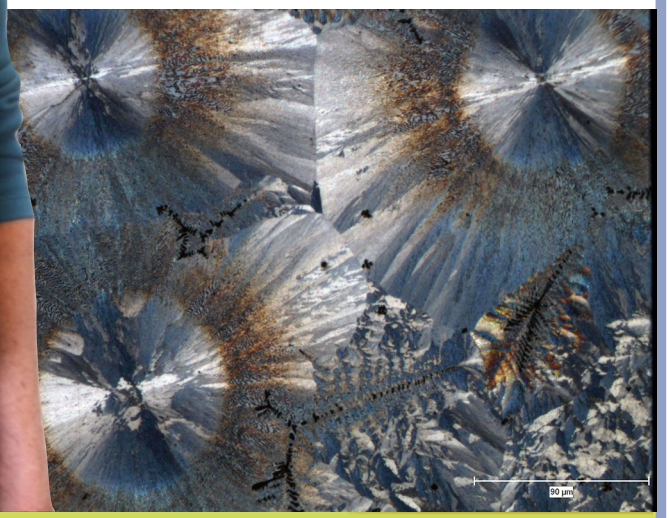


*Kelly's silver-copper (60Ag-40Cu at%) eutectic composition micrograph that was featured as the January image in the 2011 Buehler Microstructure Calendar.*

# From Jim's Desk



Since joining MST as the Division Safety Advisor in the spring of 2010, I have greatly enjoyed seeing and learning about the innovative and exciting work being conducted within the Division. One of my assignments has been to serve as the MST Environmental Management System (EMS) point-of-contact (POC) on the ADEPS team. I would like to take this opportunity to provide some information about EMS. EMS is a simple concept about understanding how your work impacts the environment and reducing those impacts. Every action great or small can make a difference ranging from substitution or elimination of hazardous chemicals and waste to turning off lights.

**Think environment!**

Every year the Directorate develops and implements an Environmental Action Plan (EAP). The FY11 EAP was developed in support of the Lab's EMS. The other ADEPS POCs are Steve Glick, lead for ADEPS and P Division, Frances Aull from LANSCE-LC, and Cathy Padro from MPA.

ADEPS has made significant progress with the implementation of the EMS over the last few years thanks to the efforts of each of you. I'll start by reminding you of where we were in 2007: the internal EMS audit stated that *"…the EMS process in ADEPS lags compared with other directorates…,"* followed by *"Communication of EMS information…was virtually non-existent…,"* and finishing up with *"…15 of 15 workers interviewed were completely unaware of the existence of ADEPS' Environmental Action Plan."* We have gotten substantially better in the past 3 years, with the 2010 findings having a decidedly more positive tone: *"ADEPS used a variety of communication tools to deliver EMS info throughout the year;" "Managers were performing environment-focused MOVs … with several exceeding the number of quarterly environmental MOVs required by the directorate;"* and *"Strides were made in identifying, consolidating and dispositioning unused and unwanted materials."* Environmental management will always be an ongoing effort. We impact the environment in many ways, and most of the time it is in a negative way. We consume resources and generate waste. Our 2011 EAP addresses our impact on the environment, and outlines actions we can take to reduce our impact. Let's look at our objectives, and the specific targets we have developed to meet the objectives.

**Objective 1: Improve environmental performance via improved integration and communication at the work level.** Managers will continue to emphasize environmental aspects during their MOVs, and we will disseminate information on the EAP using posters, group briefings, all-hands meetings, and e-mails. Everyone should think about environmental management while planning or reviewing work activities to identify improvement opportunities.

**Objective 2 – Reduce cost & increase efficiency/ operating capacity using an approach to P2 (Pollution Prevention).** We are working with the Lab's Environmental Team to understand our overall waste generation profile so that we can establish long-term waste-reduction goals. MST -7 has committed to the establishment of a centralized chemical stockroom at the Target Fabrication Facility that will reduce chemical inventory and minimize waste generation. MPA-11 will install a methanol recirculation and recovery loop to reduce the volume of liquid waste. Both of these projects were competitively selected for Generator Set Aside Funding (GSAF), a Lab program that uses funds collected from waste generators to fund waste-reduction efforts.

**Objective 3 – Reduce cost and increase efficiency via energy conservation/reductions in fuel, electricity, and $H_2O$ consumption.** Everyone can help conserve energy. Turn off lights in offices, conference rooms, hallways, and labs when not needed. Turn off computer peripherals when not in use. Contact your FOD to fix any leaking faucets or toilets. Alter your purchasing habits – Purchase GREEN. Use the blue and green recycling bins. Share chemicals, minimize chemical inventories, purchase safer alternatives, recycle, and dispose properly.

**Objective 4 – Implement Lab-wide clean-out activities to disposition unneeded equipment, materials, chemicals, and waste.** We continue our annual goal of maintaining a 97% or better chemical inventory via the Chemlog database. While performing your inventory, consider reducing your inventory by proper disposition of unneeded containers. This June, all divisions in ADEPS will participate in the Lab-wide "Recycle and Reuse Event." Details and information on this useful event will be forthcoming; I urge every group to take advantage of this "spring-cleaning" opportunity.

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***Kelly . . .*** That same passion is evident when Kelly uses her vast experience and knowledge to teach others about her field.

"If a person shows any interest in it, she will go the extra mile to help in any way she can," said teammate Robert Forsyth (MST-6), who was mentored by Kelly for nearly five years. "She has great attention to detail in everything she does."

As a teaching aid she produced *Basic Metallographic Preparation Techniques*, a Laboratory training manual stressing the importance of and detailing each process in preparing a variety of materials for optical and scanning electron microscopy. Since 2004 she has revised several chapters in the yearly editions of the *American Society of Metals Handbook*.

She has also developed several metallographic sample preparation techniques featuring mechanical, chemical, and electrochemical processes that reduce preparation time and are user and environmentally friendly. Her metallographic techniques developed for refractory metals and uranium are used in industry.

"Seeing other people get a charge out of (my field of work) gets me excited as well," Kelly said. "I want to pass along what I know and why I enjoy it so much. It was a struggle for me to create these techniques so I want to make it easier for others."

Kelly joined the Laboratory in 1980 as an MST-6 nuclear fuels quality assurance clerk for the TREAT (Transient Reactor Test) program. Five years later, when the program ended, she was given the opportunity to receive on-the-job metallography training.

"I fell in love with it," she said. "I am so lucky I got the opportunity to get into this field. It is perfect for me. The passion doesn't go away."

Kelly's micrographs have won numerous awards at competitions designed to advance the state of microstructural analysis. And recently, her silver-copper micrograph was the January image in the judged 2011 Buehler Microstructure Calendar, published by the U.S. manufacturer of materials analysis equipment and supplies. The image is similar to gazing through a kaleidoscope with varying shades of silver, copper, grey and turquoise streaming outward from a round silver-colored center.

Describing the calendar, Kelly said, "Every micrograph has its own unique characteristic and the photos are so interesting."

Kelly shows the same kind of passion in other aspects of her life as well. Several years ago, she started an informal gathering for all MST-6 members to interact outside the work environment. The social gatherings include snacks or potlucks. She also led the effort to plant a flower garden in front of the Sigma Building because she said she wanted to "bring a little piece of home" to work.

Outside of work, Kelly's interest is hummingbirds. "Those are my babies," she said. "They are curious creatures and fascinating to watch." She has five feeders at her house to attract and feed the hummingbirds, taking photos and playing with them.

Kelly's enthusiasm draws admiration from her colleagues. "She is a really upbeat and social person," Forsyth said. "And she has a great sense of humor. She is a great resource for the team because of her energy and knowledge of metallography."

## Choudhury receives TMS Young Leaders Professional Development Award

Samrat Choudhury (Structure/Property Relations, MST-8) received the 2011 Young Leader Professional Development Award from The Minerals, Metals and Materials Society (TMS). The Society created the annual award to enhance the professional development of dynamic young people from TMS's five technical divisions. Choudhury is a member of the Electronic, Magnetic, and Photonic Materials Division.

Awardees participate in Society activities, attend TMS conferences, network with Society members and leaders, receive mentoring from TMS division leaders, and serve as judges for division-sponsored student events at the TMS Annual Meeting.

After earning a PhD in materials science and engineering from Pennsylvania State University, Choudhury became a postdoctoral research associate at the University of Wisconsin–Madison. He joined Los Alamos as a Director's Postdoctoral Fellow in April 2010. His research interests include understanding the role of defects/interfaces and multi-component diffusion on micro/nanostructure formation and evolution under a variety of conditions. He links this information to material properties. Choudhury employs a multi-scale computational approach ranging from the atomistic to continuum scale. His approach includes ab-initio, cluster expansion, kinetic Monte Carlo, rate theory, and phase-field to study functional and structural properties of ceramics and alloys.

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**Choudhury . . .** The Minerals, Metals & Materials Society (TMS) is an international professional organization of nearly 10,000 members, encompassing the entire range of materials and engineering, from minerals processing and primary metals production to basic research and the advanced applications of materials.

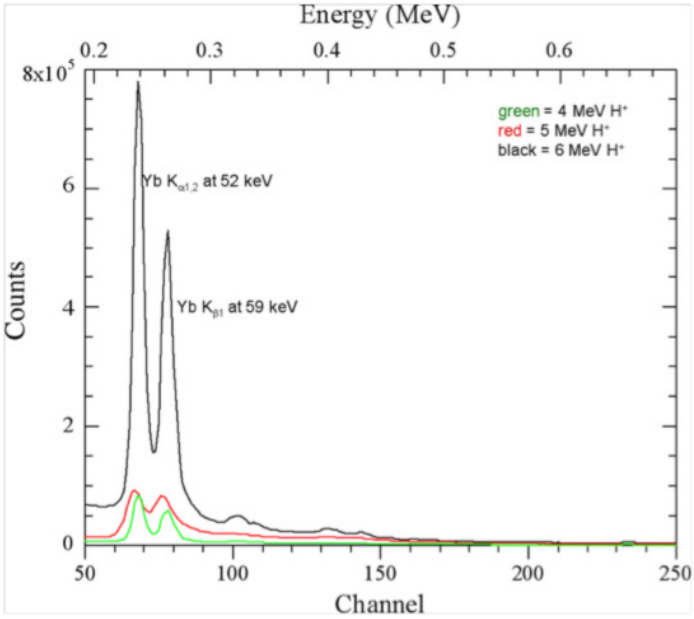
# High-energy x-rays available for materials studies

Materials Science and Technology (MST) researchers have developed a high-energy x-radiation source and an in situ gas measurement capability at the Ion Beam Materials Laboratory. Irradiating a ytterbium target with protons produces the x-rays. This newly developed experimental capability allows the study of material outgassing while irradiating with 50-60 keV x-rays.

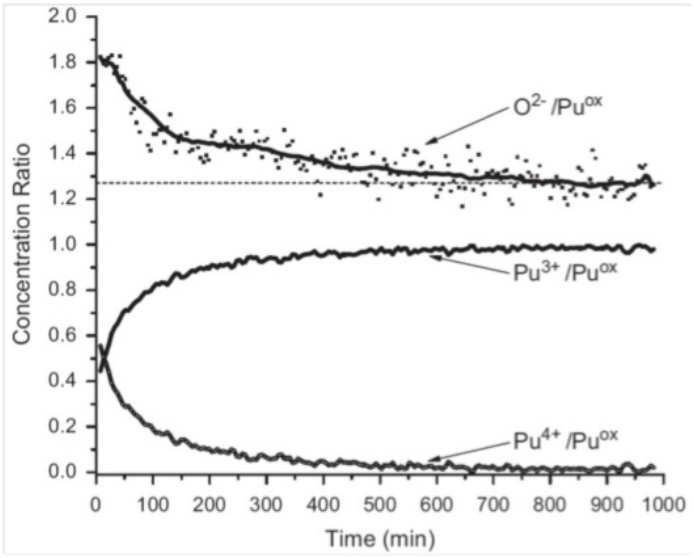
Carol Haertling (Materials Technology:Metallurgy, MST-6), Joseph Tesmer, Richard Greco, and Alexandra Webster (MST-8) conducted the work to understand the long-term effects of radiation on materials in nuclear weapons. Materials in nuclear weapons sit for long time periods while adjacent to radioactive components, such as actinides, that release 50-60 keV x-rays. The radiation can degrade materials and potentially produce gases that react with other components.

The researchers are studying lithium hydride and lithium hydroxide, which are materials used in both nuclear weapons and nuclear reactors. This capability could be used to study other materials for a variety of applications. The Enhanced Surveillance Campaign (Tom Zocco, LANL Program Manager) funds the work.

*Technical contact: Carol Haertling*




*The x-ray spectrum from ytterbium irradiated with protons reveals peaks at 50-60 keV and minimal response at higher energies.*




*Auto-reduction reaction of plutonium dioxide film on clean plutonium metal. Data acquisition began 4 minutes after 540 L oxygen exposure. As the auto-reduction reaction proceeds, the $Pu^{4+}$:$Pu^{3+}$ ratio changes from 0.55:0.45 to 100% $Pu^{3+}$. The stoichiometry decreases from 1.8 to 1.27, less than what is expected for plutonium sesquioxide ($Pu_2O_3$; $O^{2-}/Pu^{ox}$=1.5).*

# Characterization and stability of thin oxide films on plutonium surfaces

Understanding the corrosion characteristics of any metal is important in order to prevent unintended reactions that may jeopardize or alter the expected properties of the metal. Plutonium metal readily oxidizes in air to form a layered oxide system composed of plutonium dioxide ($PuO_2$) at the air–oxide interface and plutonium sesquioxide ($Pu_2O_3$) at the oxide–metal interface. At room temperature and in an inert/non-oxidizing environment, such as an ultra high vacuum system, $PuO_2$ undergoes a spontaneous, thermodynamically driven auto-reduction reaction where $Pu_2O_3$ grows at the expense of the dioxide. Given enough time in this environment, the dioxide will be completely converted. It is generally assumed that the only stable oxides of plutonium at room temperature are the dioxide and sesquioxide, even for thin oxide films on metal substrates. It was recently shown that very thin plutonium sesquioxide films under inert/non-oxidizing environments support considerable sub-stoichiometry ($Pu_2O_{3-y}$; y=0 to 1).

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***Characterization . . .*** It is unclear what role, if any, $Pu_2O_{3-y}$ plays in the oxidation/auto-reduction of plutonium.

Nuclear Materials Science (MST-16) researchers collaborated with scientists from the University of Nebraska-Lincoln and the Atomic Weapons Establishment, UK, for x-ray photoelectron spectroscopy and Auger electron spectroscopy studies of oxide films on plutonium metal surfaces. Their results provide insight on the poorly understood plutonium oxide thin-film system. The scientists measured the relative concentrations of oxygen, plutonium, and the resulting oxidation states of the plutonium species in the near-surface region. They evaluated the oxide product of the auto-reduction of plutonium dioxide films and found it to be an oxide species that is reduced further than what is expected. The data show a much greater than anticipated extent of auto-reduction. This result challenges the commonly held notion of the stoichiometric stability of $Pu_2O_3$ thin-films. The research demonstrates that a sub-stoichiometric plutonium oxide ($Pu_2O_{3-y}$) exists at the metal–oxide interface. The level of sub-stoichiometry depends, in part, on the carbidic contamination of the metal surface. Reference: "Characterization and Stability of Thin Oxide Films on Plutonium Surfaces," *Surface Science* **605**, 314 (2011). Researchers include Harry Garcia Flores (MST-16 and the University of Nebraska–Lincoln), P. Roussel (Atomic Weapons Establishment), and David Moore and David Pugmire (MST-16). The Enhanced Nuclear Safety program funded the work.

*Technical contact: David Moore or David Pugmire*

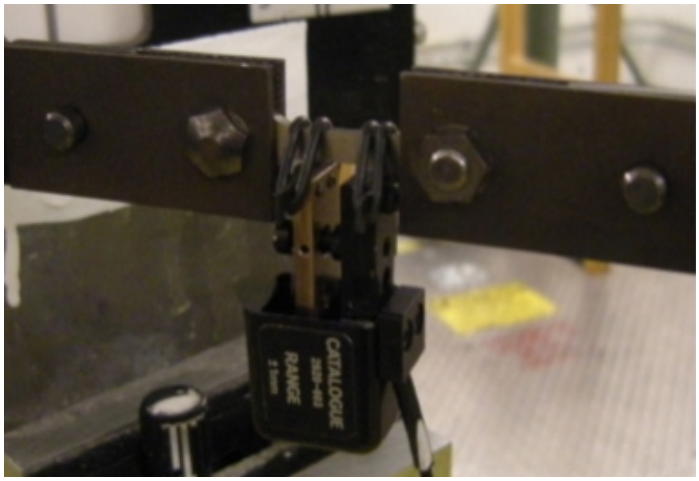
# SMARTS examines irradiation-induced evolution of deformation mechanisms

As part of the user program on the SMARTS instrument at the Lujan Neutron Scattering Center (LANSCE-LC), Thomas Sisneros (MST-8) and Bjorn Clausen (LANSCE-LC) collaborated with the research group of Mark Daymond (Queens University, Kingston, Ontario). The scientists completed in situ neutron diffraction measurements during deformation of radioactive zirconium alloy samples that had been in service in a reactor for approximately 10 years. SMARTS (Spectrometer for Materials Research at Temperature and Stress) employs neutron diffraction techniques to probe metals and structural materials. This experiment is a first step for SMARTS towards experiments on nuclear and radioactive materials. Its success has already motivated future experiments on irradiated steel samples.

Zirconium alloys find application in Canadian nuclear power reactors as cladding for fuel pellets and calandria tubes. The samples emitted 2 REM/hr of combined beta and gamma radiation on contact, necessitating special sample handling procedures that were developed with help from Scott Walker and Mike Duran (Health Physics Operations, RP-1) and Frances Aull (Industrial Safety and Deployed Services, IHS-DS). The scientists completed parallel experiments on matching legacy "pre-installation" material.

Preliminary analysis of the in situ diffraction data shows that the microstructural response of the irradiated and non-irradiated samples was markedly different. This result suggests that a different balance of deformation mechanisms is activated by the irradiation damage in the irradiated sample. Future comparison of the data collected on SMARTS with advanced polycrystalline plasticity models will yield detailed information about the active deformation modes and will be used to improve the existing calculations of in-reactor deformation and component lifetimes. The NSERC (Canadian equivalent of National Science Foundation) as well as the Canadian nuclear power industry funded the work. The DOE Office of Science supports the Lujan Center.

*Technical contact: Don Brown*




*Irradiated zirconium sample mounted in tensile grips on SMARTS.*

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***From Jim's Desk. . .*** **Objective 5 – Reduce long-term impacts, increase operational capacity, and ensure Lab sustainability through an integrated approach to site-wide planning and development.** Ensure long-term ADEPS facility needs are socialized with other Lab organizations through active participation in all phases of MaRIE and the Pajarito Corridor construction project.

Please document, record and report all significant environmental actions that you take that positively affect the environment. Please send any environmental actions to jcoy@lanl.gov or your group leadership. This will ensure that our Division continues to get the recognition it deserves for our environmental efforts. If you have any ideas for environmental improvements, please contact me so I can support and pursue funding.

*MST Division Safety Advisor Jim Coy*

# HeadsUP!

## WSST hint

The NETS (Network of Employers for Traffic Safety) Web site (trafficsafety.org/drivesafelyworkweek/index.php) and the National Safety Council Web site (www.nsc.org/Pages/ThanksgivingTrafficFatalityEstimates.aspx) have extensive information on distracted driving, including an excellent research-based article. There are a number of convincing videos available, and Focus-Driven Advocates for Cell-Free Driving has a concise fact summary, as well as a page where you can pledge to drive cell-free.

## Ensure your visitors follow security requirements

An escort is responsible for accompanying a visitor within a security area or a property protection area to ensure the visitor's adherence to security requirements. See the Security Escorting Procedure (P202-6) at policy.lanl.gov/pods/policies.nsf/LookupDocNum/P202-6/$file/P202-6.pdf for more information. Questions? Contact escortinfo@lanl.gov.

## Wear badges correctly

All badge holders, including official visitors, must wear their badges photo-side out, above the waist, and on the front side of the body at all times while on Laboratory property. See the Security Badges Procedure (P203-1) at policy.lanl.gov/pods/policies.nsf/LookupDocNum/P203-1/$file/P203-1.pdf for more information. Contact: security@lanl.gov.

## New review and approval system for DUSA publications

The Research Library, in collaboration with Classification (SAFE-1), is providing a new Review and Approval System (review.lanl.gov) for Designated Unclassified Subject Area (DUSA) publications that are submitted for an LA-UR number. This system allows Los Alamos employees to electronically submit unclassified material that qualifies under a DUSA category—it no longer is necessary to submit a DUSA document to SAFE-1 to receive an LA-UR number.

After the electronic submission is received, an e-mail is sent automatically to the responsible line manager for online approval. Once he or she approves, an LA-UR number will be assigned immediately. These documents will then be stored and made available as part of the Research Library's Los Alamos Authors Publications database within 30 days. Questions or comments? Contact rassti@lanl.gov.

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